3.0 TMDL ENDPOINT DETERMINATION

To meet the designated uses in the Christina River Basin, water quality targets, or endpoints, must be achieved under the variable flow conditions. The selection of these endpoints considers the water quality standards prescribed by those designated uses (Section 1.3), but where no numeric criteria were found in the standards, interpretations of the narrative standard or site-specific endpoints were applied.

3.1 Bacteria TMDL Endpoints

In Pennsylvania, the TMDL target endpoints for bacteria are the fecal coliform bacteria water quality standards presented in Table 1-6. These targets represent numbers where the applicable water quality is achieved and maintained to protect designated uses. In these TMDLs, the targets were selected to maintain recreational contact uses during both the swimming and non-swimming seasons. During the swimming season, from May 1 through September 30, the 30-day geometric mean fecal coliform bacteria levels must be less than the target value of 200 cfu/100mL and not more than 10 percent of fecal bacteria concentrations within a 30-day period can exceed 400 cfu/100mL. During the non-swimming season (October 1 through April 30), the 30-day geometric mean target level is 2,000 cfu/100mL.

In Delaware, the TMDL target endpoint for bacteria is the *enterococcus* bacteria geometric mean water quality standard presented in Table 1-7. The target were selected to protect the primary contact recreation designated use in freshwaters in Delaware. The TMDL target endpoint for *enterococcus* bacteria is the geometric mean concentration of 100 cfu/100mL. The proposed *enterococcus* bacteria TMDLs in Delaware used both the geometric mean and the single sample maximum. However, based on the Environmental Protection Agency's 2004 explanation[1] of the appropriate (see below) use of the single sample maximum criterion, these established *enterococcus* bacteria TMDLs in Delaware are based on the geometric mean criterion only. It should be noted that the TMDL, WLA, and LA values remain unchanged from the proposed values.

In promulgating the 2004 final rule, *Water quality Standards for Coastal and Great Lakes Recreational Waters* rule, the preamble to the final rule discusses comments received regarding the implementation of the single sample maximum criterion and the intent of EPA's *Ambient Water Quality Criteria for Bacteria –1986*[2]. The 1986 bacteria criteria document did not discuss using the single sample maximum as a never-to-be-surpassed value for all applications under the CWA. The geometric mean is the more relevant value for describing the risk of contact recreation uses and the single sample maximum criterion is best used for making beach notification and closure decisions based on limited data. In the future, DNREC intends to limit the use of the single sample maximum to beach closures or to where decisions must be made with limited data. Because the daily simulations from October 1, 1994, through

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[1] 69 *FR* 67218-67243
[2] EPA 440/5-84-002, January 1986

October 1, 1998, provide adequate data for use of the geometric mean as the indicator of attainment of water quality standards, the single sample maximum criterion is not used for these TMDLs.

3.2 Sediment TMDL Endpoints

Pennsylvania's narrative standard, Chapter 93.6(a), must be interpreted with respect to sediment. PADEP uses a reference watershed approach to develop TMDL endpoints for the allowable sediment loading rates in the impaired watersheds.

3.2.1 Reference Watershed Approach

The reference watershed approach was used to estimate the necessary sediment load reduction required to restore a healthy aquatic community and allow the streams in the impaired watershed to achieve their designated uses. In the reference watershed approach, two watersheds are used, one attaining its uses and the other being impaired. Both watersheds must have similar land cover and land use characteristics. Other features such as base geologic formation, soils, percent slope, and geographic eco-region should be matched to the extent possible. The objective of this process is to reduce the loading rate of sediment in the impaired watershed to a level equivalent to or slightly lower than the loading rate in the unimpaired reference watershed. Achieving the sediment loadings recommended in the TMDLs will ensure protection of the designated aquatic life of the impaired watershed.

3.2.2 Considerations for Reference Watershed Selection

Two factors form the basis for selecting a suitable reference watershed. First, the watershed must have been assessed by PADEP and determined to be attaining water quality standards and meeting designated uses. Second, the watershed should closely resemble the impaired watershed in physical properties such as land cover, land use, physiographic province, size and geology. The 35 subbasins used in the modeling were screened for an unimpaired subbasin.

There are four steps in matching a reference watershed to an impaired watershed (see Figure 3-1). The first step is to locate watersheds that have been recently assessed and are not impaired. Step 2 is to identify a pool of unimpaired watersheds similar in size and geology to the impaired watersheds. Step 3 involves comparing the land cover data of the watersheds and selecting unimpaired watersheds that had land cover characteristics similar to those of the impaired watersheds. Land use distributions were compared on a percentage basis as calculated from HSPF land use input data. It is important to have a good match between the sizes of the reference and impaired watersheds so that reasonable comparisons could be made. As a result, the Step 4 is to resize the reference watersheds to produce a load that reasonably matches the impaired watersheds.

Once the reference watersheds were selected, their existing sediment loads were estimated based on the HSPF watershed model simulation. The estimated existing reference watershed sediment loads were then considered as the target endpoints the impaired watersheds.

3.2.3 Selected Reference Watershed and Endpoints

The TMDL endpoints established for this study were determined using the reference watersheds listed in Table 3-2 and shown in Figure 3-2. The methodology used for identification of candidate reference watersheds and final selection of reference watersheds for the TMDL target is outlined in Appendix K of the model report (USEPA, 2005). The listed segments in the Brandywine Creek watershed were grouped as either a predominately residential/urban watershed or a rural/agricultural watershed based on the land use characteristics of their associated HSPF model subbasin (see Table 3-1). The TMDL sediment endpoints (as unit area loads) for each of the reference watersheds are presented in Table 3-2. The TMDL process uses these loading rates in the non-impaired watersheds as targets for loading reductions in the impaired watersheds.

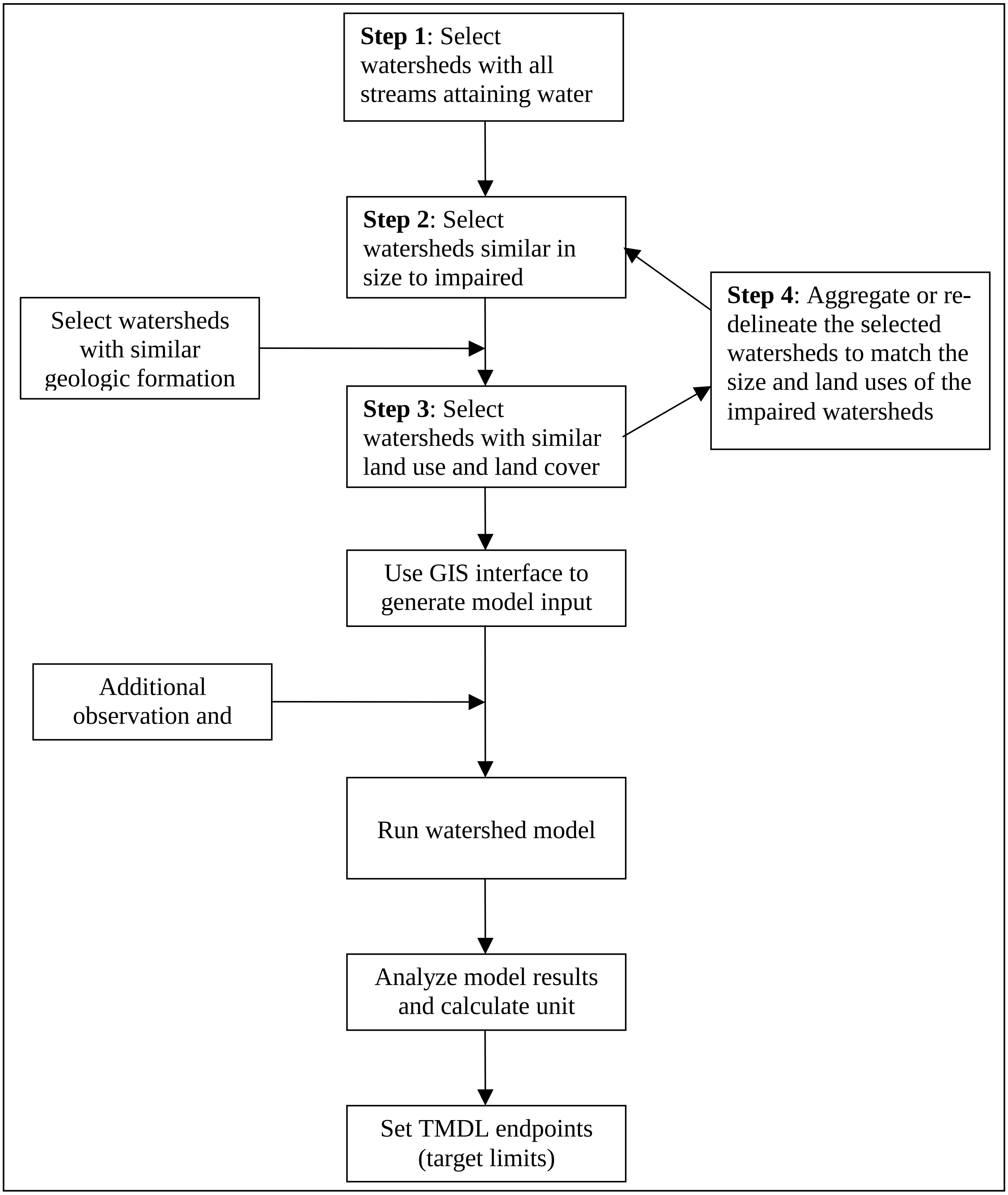

Figure 3-1. Reference watershed approach for derivation of TMDL target limits

Table 3-1. Land use characteristics of impaired subbasins and reference watersheds

HSPF Subbasin	Area (sq.mi.)	Land uses (percent)			Predominate Watershed Type
		Residential-Urban	Agriculture-Rural	Forested-Wetland	
Subbasins impaired by siltation in Brandywine Creek watershed:					
B01	18.39	7.9	68.1	20.6	Rural
B05	8.82	38.6	19.1	36.3	Residential-Urban
B06	8.06	22.7	39.6	35.9	Residential-Urban
B09	14.68	8.3	54.0	35.4	Rural
B14	12.92	32.3	31.9	31.2	Residential-Urban
B15	10.36	33.6	40.7	17.8	Residential-Urban
B20	25.54	13.3	58.8	25.9	Rural
B31	9.19	26.8	48.8	22.4	Residential-Urban
Subbasins impaired by siltation in White Clay Creek watershed:					
W01	10.23	19.4	51.8	26.2	Rural
W02	9.51	16.7	63.4	17.9	Rural
W03	6.35	18.3	44.7	36.4	Rural
W04	6.20	14.1	57.5	24.0	Rural
W06	8.57	5.4	67.5	22.0	Rural
W07	1.37	16.8	62.0	19.0	Rural
W08	7.47	14.6	50.4	32.9	Rural
W09	6.85	31.1	32.7	33.3	Residential-Urban
Subbasins impaired by siltation in Red Clay Creek watershed:					
R01	10.08	18.2	58.6	18.8	Rural
R02	7.39	15.2	58.4	25.4	Rural
R03	9.90	21.4	47.3	23.1	Residential-Urban
Reference Watersheds:					
B25	5.83	26.8	40.7	30.5	Brandywine Cr. – Urban
B32	4.66	14.2	31.6	53.0	Brandywine Cr. – Rural
R04	5.11	44.7	17.8	29.2	Red Clay Creek
W10	3.58	18.8	27.1	53.7	White Clay Creek

Table 3-2. Sediment endpoints for Christina River Basin TMDL

Reference Watershed ID	Watershed Name	Unit Area Sediment Load (tons/acre/year)
B25	Broad Run (Brandywine Creek)	0.089
B32	Birch Run (Brandywine Creek)	0.045
R04	Red Clay Creek	0.635
W10	White Clay Creek	1.043

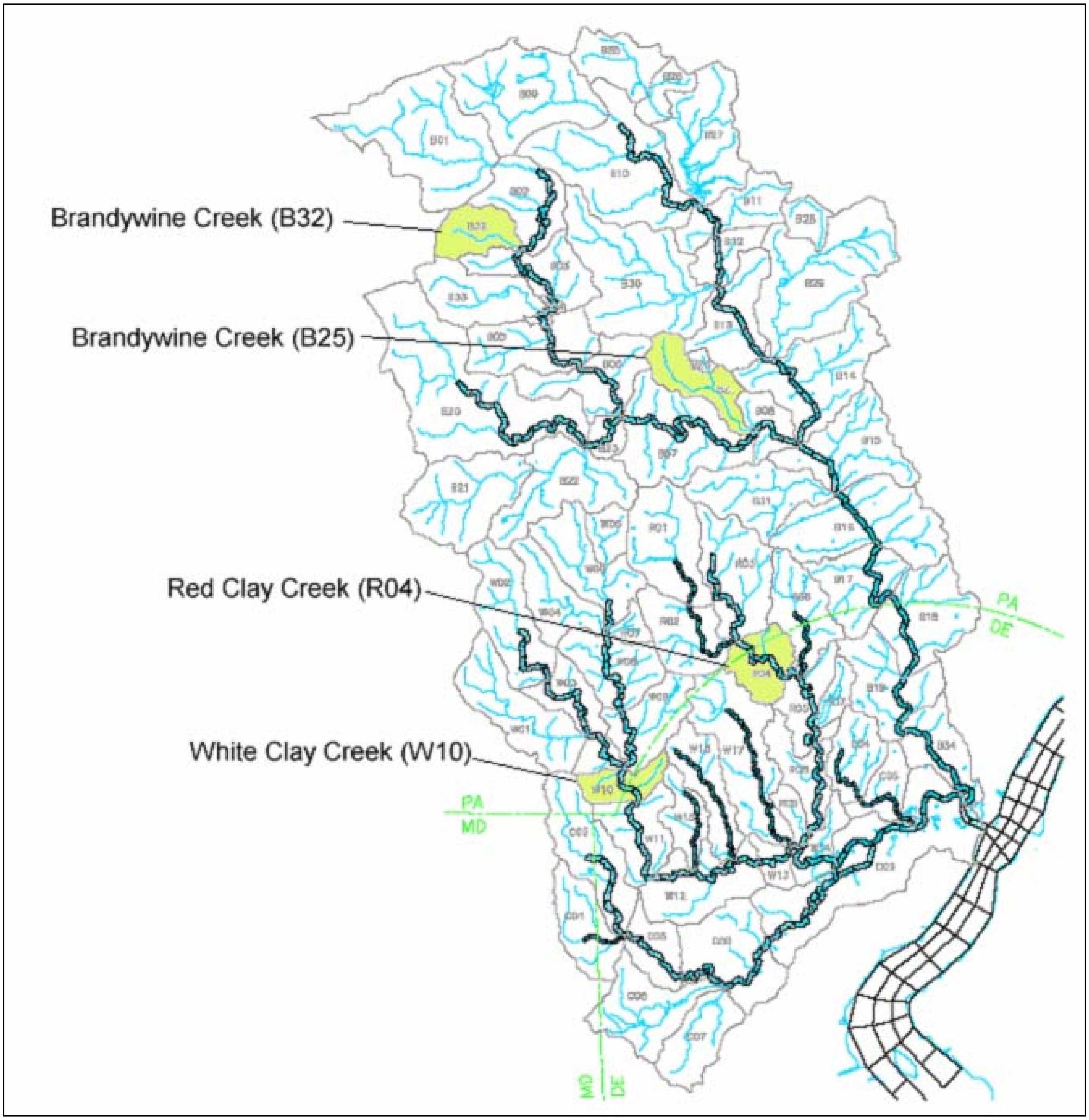

Figure 3-2. Locations of reference watersheds in Christina River Basin